BMP #43 - Infiltration Trench

Targeted Pollutants

75% Sediment

55% Phosphorus

- Trace metals
- Bacteria
- Petroleum hydrocarbons

Physical Limits

Drainage area	10 ac
Max slope	20%
Min bedrock depth	4 ft
Min dist to water table	3 ft
SCS soil type	A, B
Freeze/Thaw	fair
Drainage/Flood control	N/A

DESCRIPTION

Infiltration facilities such as trenches and Bioretention Basin (BMP #44) are designed to intercept and reduce direct site surface runoff. They hold runoff long enough to allow it to enter the underlying soil. They can include layers of coarse gravel, sand or other filtering media to filter the runoff before it infiltrates the soil.

Infiltration trenches are shallow (three to twelve feet deep) trenches in relatively permeable soils that are backfilled with a sand filter, coarse stone, and lined with filter fabric. The trench surface can be covered with grating and/or consist of stone, gabion, sand, or a grassed covered area with a surface inlet. Depending on the design, trenches allow for the partial or total infiltration on stormwater runoff into the underlying soil. One alternative design is to install a pipe in the trench and surround it with coarse stone; this will increase the temporary storage capacity of the trench.

APPLICATION AND LIMITATIONS

An infiltration trench will generally be used in relatively small drainage areas (usually less than 10 acres), such as on residential lots. Trenches are one of the few BMPs that are relatively easy to fit into the margin, perimeter, and other less-utilized areas of developed sites, making them particularly suitable for retrofitting. Unlike infiltration basins (BMP #44) installed at the surface, the land above a subsurface trench system can be reclaimed and used. A trench may also be installed under a drainage swale to increase the storage of the infiltration system.

Appropriate soil conditions and the protection of groundwater are the most important considerations limiting the use of this BMP. Infiltration rates must be 0.5 inches (1.3 cm) /hour or greater). Generally speaking, SCS Type A and B soils will convey water at this rate, but site-specific testing should be done to confirm the infiltration rate. Other soil conditions that will *not* support the use of infiltration trenches include:

- Soils with more than 40% clay content (subject to frost heave)
- Fill soils, unless the fill material is specially designed to accommodate the facility
- Steep slopes (>25%) which can contribute to slope failures

Infiltration facilities are not suitable in many areas of Idaho where the groundwater table is very shallow. Observe conditions at the site when the water table is at its highest. If the minimum depth to groundwater at these times is 3 feet from the proposed bottom of the infiltration trench bed, and the other noted soil conditions are right, infiltration can be used. If depth to the water table is shallower, there is an increased risk of groundwater contamination.

One advantage to trenches is that they are less likely to become clogged with sediment than do other infiltration BMPs such as basins (BMP #44). However, clogging is still an issue. This BMP should typically be located "off-line" from the primary conveyance/detention system in order to effectively treat pollutants and protect the infiltration soils from clogging. Infiltration trenches should always be preceded by a pretreatment BMP to remove sediments that could clog the infiltration soils. Infiltration trenches are not suitable for sites with exposed chemical or toxic materials. If there is the potential for a toxic spill, a spill prevention and control plan must be in place.

As with any type of infiltration facility, infiltration trenches should not be used in areas with shallow aquifers. An official inventory form must be submitted to the Idaho Department of Water Resources. Contact the closest regional office for further information.

Conservatively speaking, the longevity of trenches is expected to be about two years before partial of full clogging/sealing of the floor. The life span can be significantly increased given good permeable soils and pretreatment to prevent clogging. The relatively short life span of infiltration facilities can be significantly increased through proper design and maintenance.

Design Parameters

The procedure for sizing infiltration trenches should follow a Darcy’s Law approach, as described in BMP #40 (Sand Filters) presented earlier in this Catalog. Typical dimensions are 3 feet (0.9 m) wide and 3 to 12 feet (0.9 to 3.7 m) deep. Additional design parameters specific to infiltration trenches are given below.

Soils Investigation. A minimum of one soils log should be collected for every 50 feet of trench length, and in no case less than two soils logs for each proposed trench location. Each soils log should extend to a minimum depth of the high water table below the bottom of the trench, describe the NRCS (SCS) series of the soil, the textural class of the soil horizon(s) through the depth of the log (soil and structures), and note any evidence of high ground water level, such as mottling. In addition, the location of impermeable soil layers or dissimilar soil layers should be determined. The design infiltration rate, fd, will be equal to one-half the infiltration rate found from the soil textural and structural analysis.

Pretreatment. It is recommended that all infiltration trenches be preceded by a pretreatment BMP, such as a presettling basin (BMP #50), a vegetated swale (BMP #38) or a simple sump (see wet/vault tank design, BMP #51). A vegetated filter stip (BMP #39) at least 20 feet wide appears to work well. A level spreader (BMP #53) may be used to spread out concentrated flows. Regular maintenance of the pretreatment device is critical.

Drawdown Time. Infiltration trenches should be designed to completely drain stored runoff within one day following the occurrence of the 6-month, 24-hour design storm. Thus, a maximum allowable drawdown time of 24 hours should be used. This will ensure that the necessary aerobic conditions exist in order to provide effective treatment of pollutants. If a presettling basin (BMP #50) precedes the infiltration trench, the combined drawdown time for both BMPs should be 24 hours.

Backfill Material. The aggregate material for the infiltration trench should consist of a clean aggregate with a maximum diameter of 3 inches and a minimum diameter of 1.5 inches. The aggregate should be graded such that there will be few aggregates smaller than the selected size. Void space for these aggregates is assumed to be in the range of 30 percent to 40 percent.

Geotextile Fabric. The aggregate fill material should be completely surrounded with an engineering geotextile. In the case of an aggregate surface, should surround all of the aggregate fill material except for the top one foot.

Overflow Channel. In general, because of the small drainage areas controlled by an infiltration trench, an emergency spillway is not necessary. In all cases, the overland flow path of surface runoff exceeding the capacity of the trench should be evaluated to preclude the development of uncontrolled, erosive, concentrated flow. A nonerosive overflow channel leading to a stabilized watercourse should be provided.

Seepage Analysis and Control. An analysis should be made to determine any possible adverse effects of seepage zones when there are nearby building foundations, basements, roads, parking lots or sloping sites. Developments on sloping sites often require the use of extensive cut and fill operations. The use of infiltration trenches on fill sites is not permitted.

Buildings. Trenches should be a minimum of 100 feet upslope and 20 feet downslope from any building foundation or water supply well.

Land Use. Infiltration facilities are not recommended under surfaces that are expected to have traffic loads, such as driveways and parking lots. Soils become too compacted and access is difficult.

Observation Well. An observation well should be installed for every 50 feet of infiltration trench length. The observation well will serve two primary functions: it will indicate how quickly the trench dewaters following a storm and it will provide a method of observing how quickly the trench fills up with sediments. The observation well should consist of perforated PVC pipe, 2 to 4 inches in diameter. It should be located in the center of the structure and be constructed flush with the ground elevation of the trench. The top of the well should be capped to discourage vandalism and tampering. More specific construction information can be obtained by contacting Idaho Department of Water Resources (IDWR) or DEQ.

CONSTRUCTION GUIDELINES

Construction Timing . An infiltration trench should not be constructed or placed into service until all of the contributing drainage area has been stabilized and approved by the appropriate agency.

Trench Preparation. Excavate the trench to the design dimensions. Excavated materials should be placed away from the trench sides to enhance wall stability. Care should also be taken to keep this material away from slopes, neighboring property, sidewalks and streets. It is recommended that this material be covered with plastic if it is to be left in place for more than 30 days.

Fabric Laydown. The geotextile fabric (a fabric that is defined as "non-woven, spunbonded and needlepunched") must be cut to the proper width prior to installation. The cut width must include sufficient material to conform to the trench perimeter irregularities and for a 12 inch minimum top overlap.

Place the geotextile over the trench and unroll a sufficient length to allow placement of the fabric down into the trench. Stones or other anchoring objects should be placed on the geotextile at the edge of the trench to keep the lined trench open during windy periods. When overlaps are required between rolls, the upstream roll should overlap a minimum of 2 feet over the downstream roll in order to provide a shingled effect. The overlap insures geotextile continuity and allows the geotextile to conform to the excavated surface during aggregate placement and compaction.

Stone Aggregate Placement and Compaction. The stone aggregate should be placed in lifts and compacted using plate compactors. As a rule of thumb, a maximum loose lift thickness of 12 inches is recommended. The compaction process ensures geotextile conformity to the excavation sides, thereby reducing potential soil piping, geotextile clogging, and settlement problems.

Overlapping and Covering. Following the stone aggregate placement, the geotextile fabric should be folded over the stone aggregate to form a 12 inch minimum longitudinal overlap. The desired fill soil or stone aggregate should be placed over the lap at sufficient intervals to maintain the lap during subsequent backfilling.

Care should be exercised to prevent natural or fill soils from intermixing with the stone aggregate. All contaminated stone aggregate should be removed and replaced with uncontaminated stone aggregate.

Voids Behind Geotextile. Voids that may be created between the geotextile and excavation sides should be avoided. Native soils should be placed in these voids at the most convenient time during construction to ensure fabric conformity to the excavation sides. Soil piping, fabric clogging, and possible surface subsidence will be minimized by utilizing this remedial process.

Unstable Excavation Sites. Vertically excavated walls may be difficult to maintain in areas where the soil moisture is high or where soft or cohesionless soils predominate. These conditions require laying back of the side slopes to maintain stability; trapezoidal rather than rectangular cross-sections may result. This is acceptable, but any change in the shape of the stone reservoir needs to be taken into consideration in size calculations.

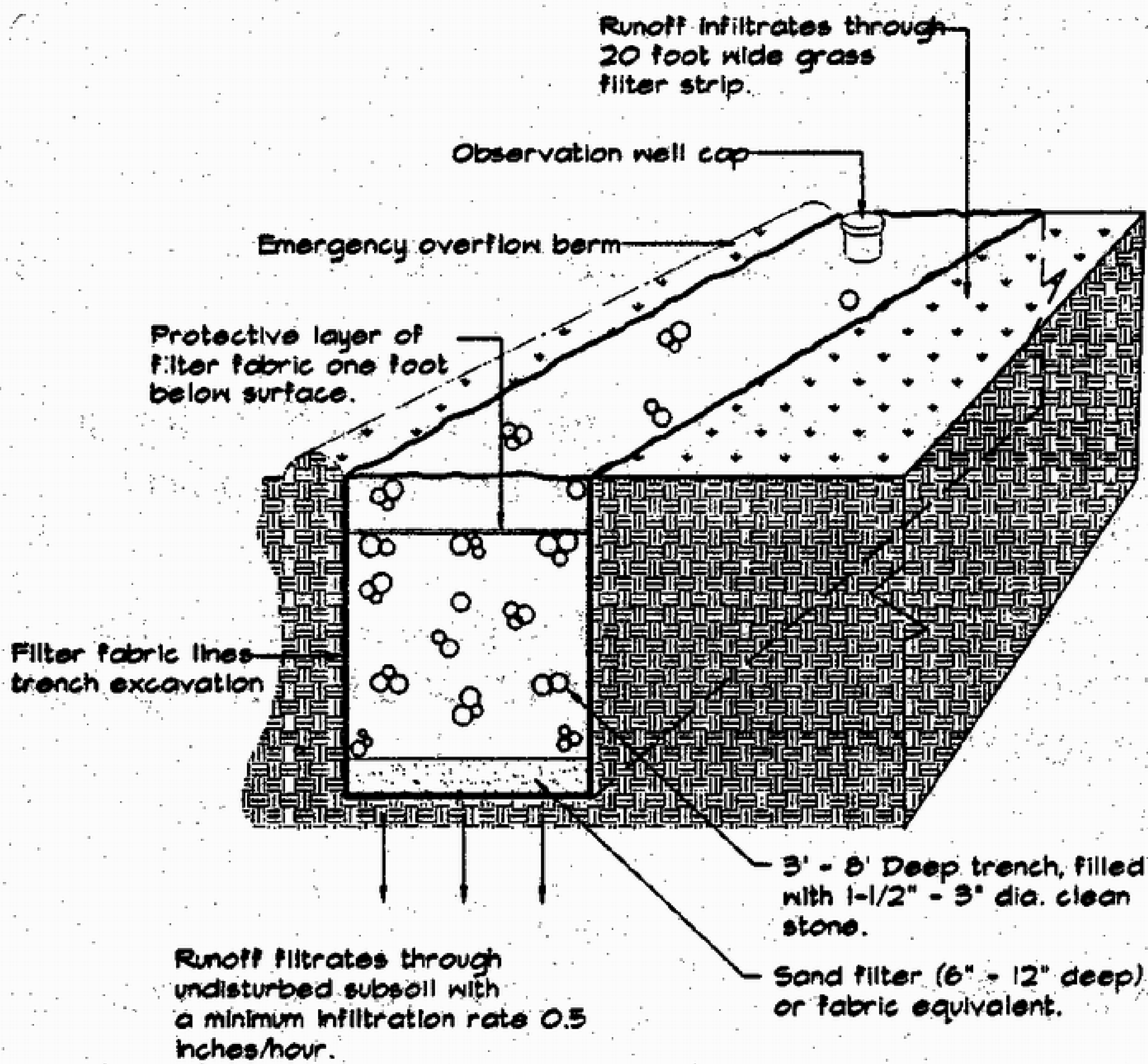
Traffic Control. Heavy equipment and traffic should be restricted from traveling over the infiltration areas to minimize compaction of the soil. The trench should be flagged or marked to keep equipment away from the area.

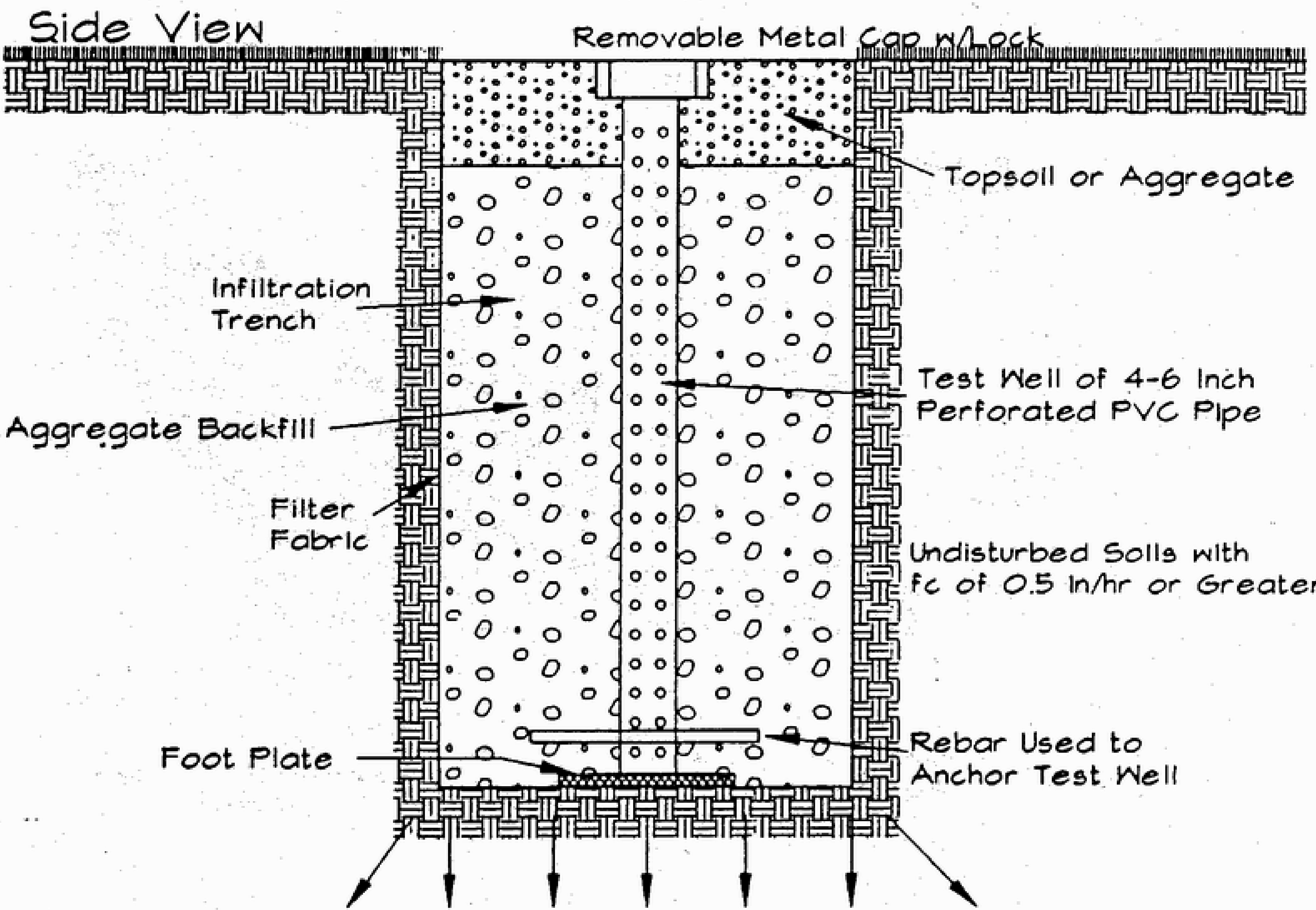
Maintenance

Inspection Schedule. The observation well should be monitored for water quality periodically. For the first year after completion of construction, the well should be monitored after every large storm (greater than one inch in 24 hours), and during the period from October 15 to April 15, inspections should be conducted monthly. From April 16 through October 14, the facility should be monitored on a quarterly basis. A log book should be maintained by the responsible person designated by the local government indicating the rate at which the facility dewaters after large storms and the depth of the well for each observation. Once the performance characteristics of the structure have been verified, the monitoring schedule can be reduced to an annual basis unless the performance data indicate that a more frequent schedule is required.

Sediment Removal. Sediment buildup in the top foot of stone aggregate or the surface inlet should be monitored on the same schedule as the observation well. A monitoring well in the top foot of stone aggregate should be required when the trench has a stone surface. Sediment deposits should not be allowed to build up to the point where it will reduce the rate of infiltration into the trench.

Pretreatment BMPs. BMPs used for pretreatment should be inspected regularly. Sediment deposits should be removed and grassy swales or filter strips should be mowed. Repair any erosion in pretreatment swales or filter strips that might concentrate runoff flow prior to the infiltration trench.


Runoff infiltrates through 20 foot wide grass filter strip.
Observation well cap
Emergency overflow berm
Protective layer of filter fabric one foot below surface.
Filter fabric lines trench excavation
3' - 8' Deep trench, filled with 1-1/2" - 3" dia. clean stone.
Runoff filtrates through undisturbed subsoil with a minimum infiltration rate 0.5 inches/hour.
Sand filter (6" - 12" deep) or fabric equivalent.


Side View
Removable Metal Cap w/Lock
Topsoil or Aggregate
Infiltration Trench
Test Well of 4-6 Inch Perforated PVC Pipe
Aggregate Backfill
Filter Fabric
Undisturbed Soils with fc of 0.5 In/hr or Greater
Rebar Used to Anchor Test Well
Foot Plate